GOVT. COLLEGE OF ENGINEERING,

AMRAVATI

B. Tech. (Instrumentation)

VII & VIII Semester

Department of Instrumentation Engineering

2010-11

GOVERNMENT COLLEGE OF ENGINNERING AMRAVATI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

B.Tech. (Instrumentation Engineering)

Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
						Theory				Practical		Total	
		Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	TA	CT1	CT2	ESE	Internal	External		
Sem III													
IN301	Engineering Mathematics III	4	1	---	5	10	15	15	60	---	---	100	5
IN302	Electronic Devices & Circuits	4	---	---	4	10	15	15	60	---	---	100	4
IN303	Signal & System	4	1	---	5	10	15	15	60	---	---	100	5
IN304	Circuit Theory	4	---	---	4	10	15	15	60	---	---	100	4
IN305	Digital Electronics	4	---	---	4	10	15	15	60	---	---	100	4
IN306	Electronic Devices & Circuits Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN307	Circuit Theory Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN308	Digital Electronics Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN309	Computational method lab -I*	---	---	2	2	---	---	---	---	50	50	100	2
Total		**20**	**2**	**8**	**30**	**50**	**75**	**75**	**300**	**125**	**125**	**750**	**27**
Sem IV													
IN401	Engg. Mathematics IV	4	1	---	5	10	15	15	60	---	---	100	5
IN402	Sensors& Transducer	4	---	---	4	10	15	15	60	---	---	100	4
IN403	Control System Component	4	---	---	4	10	15	15	60	---	---	100	4
IN404	Numerical Methods	4	1	---	5	10	15	15	60	---	---	100	5
IN405	Linear Integrated Circuits	4	---	---	4	10	15	15	60	---	---	100	4
IN406	Sensors& Transducer Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN407	Control System Component Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN408	Linear Integrated Circuits Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN409	Computational Method Lab -II**	---	---	2	2	---	---	---	---	50	50	100	2
Total		**20**	**2**	**8**	**30**	**50**	**75**	**75**	**300**	**125**	**125**	**750**	**27**
Sem V													
IN501	Microprocessor Based Instrumentation	4	1	---	5	10	15	15	60	---	---	100	5
IN502	Chemical & Analytical Instrumentation	4	---	---	4	10	15	15	60	---	---	100	4
IN503	Digital Signal Processing	4	---	---	5	10	15	15	60	---	---	100	5
IN504	Electronic Instrumentation	4	1	---	4	10	15	15	60	---	---	100	4

IN505	Material Science & Process	4	---	---	4	10	15	15	60	---	---	100	4
IN506	Microprocessor Based Instrumentation Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN507	Chemical & Analytical Instrumentation Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN508	Electronic Instrumentation Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN509	General Proficiency-I	---	---	2	2	---	---	---	---	50	50	100	1
Total		**20**	**2**	**8**	**30**	**50**	**75**	**75**	**300**	**125**	**125**	**750**	**27**

Sem VI

IN601	Distributed Control System	4	---	---	4	10	15	15	60	---	---	100	4
IN602	Microcontroller & It's Application	4	---	---	4	10	15	15	60	---	---	100	4
IN603	Power Electronics	4	---	---	4	10	15	15	60	---	---	100	4
IN604	Power Plant Instrumentation	4	---	---	4	10	15	15	60	---	---	100	4
IN605	Feedback Control System	4	---	---	4	10	15	15	60	---	---	100	4
IN606	Distributed Control System Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN607	Microcontroller & It's Application Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN608	Power Electronics Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN609	General Proficiency-II	---	---	2	2	---	---	---	---	50	---	50	2
IN610	Minor Project	---	---	2	2	---	---	---	---	50	---	25	2
Total		**20**	---	**10**	**30**	**50**	**75**	**75**	**300**	**175**	**75**	**750**	**27**

Sem VII

IN701	Modern Control Theory	4	---	---	4	10	15	15	60	---	---	100	4
IN702	Biomedical Instrumentation	3	---	---	4	10	15	15	60	---	---	100	4
IN703	Instrumentation System Design	4	---	---	4	10	15	15	60	---	---	100	4
IN704	Operation Research & Management	4	---	---	4	10	15	15	60	---	---	100	4
IN705	Elective-I	4	---	---	4	10	15	15	60	---	---	100	4
IN706	Biomedical Instrumentation Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN707	Instrumentation System Design Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN708#	Seminar & Project	---	---	6	6	---	---	---	---	50	100	150	5
Total		**20**	---	**10**	**30**	**5**	**75**	**75**	**300**	**100**	**150**	**750**	**27**

Sem VIII

IN801	Process Instrumentation & Control	4	---	---	4	10	15	15	60	---	---	100	4
IN802	Project Engineering & Management	4	---	---	4	10	15	15	60	---	---	100	4
IN803	Elective -II	4	1	---	5	10	15	15	60	---	---	100	5

IN804	Elective-III	4	1	---	5	10	15	15	60	---	---	100	5
IN805	Process Instrumentation & Control Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN806	Project Engineering & Management Lab	---	---	2	2	---	---	---	---	25	25	50	1
IN807#	Project- II	---	---	8	8	---	---	---	---	100	150	250	7
Total		**16**	**2**	**12**	**30**	**40**	**60**	**60**	**240**	**150**	**200**	**750**	**27**

Duration of ESE is 2 Hrs 30 Minutes for all courses

TA :Teacher Assessment **CT: Class Tests** **ESE: End Sem. Examination**

 # For project there will be 4 students in each batch

*** Lab-I has programming based on basic MATLAB**

**** Lab -II has programming based on MATLAB toolbox like neural network, fuzzy logic optimization**

Electives

Elective-I (IN705)	Elective-II (IN803)	Elective-III (IN804)
A) Opto- Electronics Instrumentation	A) Advance Sensors	A) Image Processing
B) Instrumentation for agriculture & Food Processing	B) Neural Network and Fuzzy logic control	B) Adaptive Control
C) Embedded Systems	C) Computer Network	C) System Identification
D) Biomedical Signal Processing	D) Digital Control System	D) Nonlinear Control

IN 701 MODERN CONTROL THEORY

Teaching Scheme : 04L + 00T Total 04 Credit: 04

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE Total Marks: 100

Duration of ESE : 2hrs 30min.

State Space Description for multivariable Control Systems: State variable modeling of linear system, the concept of state variable and state models, State space representation using phase, physical and canonical variables & their block diagram representation, Plant models of some illustrative control systems

State Variable Analysis: State model & transfer function , diagonalization, solution of state equation, state transition matrix, it's properties & computation, concept of controllability & oberservability & their test criterion, controllability & oberservability canonical forms.

State space Design: Linear state variable feedback, effect of state variable feedback on controllability & oberservability, necessary & sufficient condition for arbitrary pole placement, Ackermann's formula for pole placement, state observers: full-order state observers & minimum order design of control system with observer, design of servo system, study of some physical plant like inverted pendulum for analysis & design.

Stability: Fundamentals of Lyapunov Theory: equilibrium points, concept of stability, Lyapunov's direct method: Positive Definite function & Lyapunov's function, equilibrium point theorem, system analysis based on Lyapunov's direct method, analysis of LTI systems.

Introduction to Optimal Control System: Linear quadratic regulator(LQR): Theory & design, LQR solution using the minimum principle, Generalization of LQR , LQR properties with classical interpretation.

Text Book:

1. "Linear system theory", by Thomas Kailath 2nd edition 2005 PHI.
2. "Modern Control System Theory", Gopal M. , 2nd Edition, New Age International (P) Limited, New Delhi, 1996.

Reference Books:

1. "Modern Control Engineering", Ogata K., Fourth Edition, Prentice Hall of India 2002.

2. “Feedback Control of Dynamic System”, Franklin G., Powell j. D., & Naeini A. E., Fourth Edition, Pearson Education .
3. “Control System Engineering”, Nagrath J. and Gopal M., Second Edition, Wiley Eastern Limited, Sixteenth reprint 1990.
4. “Control Systems, Principles and Design”, Gopal M., Second Edition, TMH, New Delhi, 2002.
5. “Automatic Control Systems”, B.C. Kuo, Seventh Edition, Prentice Hall of India, New Delhi, 2002.
6. “Applied Nonlinear Control”, Slotine J.E., and Li W., Prentice Hall International, 1991.
7. “Modern Control Design with MATLAB and SIMULINK”, Tewari, A., John Wiley and Sons, Ltd., 2002.
8. “Control System Design: An Introduction to State-space Methods”, Friedland B., McGraw Hill International Edition, Singapore, 1987.

IN 702 BIOMEDICAL INSTRUMENTATION

Teaching Scheme : 04L + 00T Total 04 **Credit: 04**

Evaluation Scheme: 15CT1 + 15CT2 + 10TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction: To instrumentation, Biomedical Instrumentation, classification of biomedical Instruments, Justification of biomedical instrumentation, Scope for Biomedical Engineers.

Introduction to Human Body: Anatomy, Physiology, Electrophysiology, Electrode system, Electronics.

Basic Principle: Construction Classification, operation, testing, design, problems analysis, research, manufacturers, safety, application, artifacts costing, electronics, software, hardware etc. i. BP Apparatus, ii. Audiometers, iii. EEG, iv. X-ray, v. Dialyser, vi. Pacemaker, vii. Defibrillator, viii. Phonocardiograph, ix. Spiro meter, x. Blood Analysis Instruments.

Electrical properties of: Tissues, Shock Analysis, Shock Prevention, Instrument Safety Design, cases, electric systems design, safety standards Design of biomedical instrumentation for utility, safety ergonomics, cost, space, ventilation, operation, maintenance, installation requirement. Documents, testing, design problem and solutions.

Biomedical signal processing: ECG signal analysis, ECG QRS detection EEG signal analysis for Epilepsy activity, artifact detection and elimination, intelligent testing. Medical imaging: Diagnostic X-Ray_Properties, X-ray units, x-ray machines & generation process, special imaging techniques for X-rays.

Text Book:

1. "Hand book of Biomedical Instrumentation", by Khandpur R. S., 2nd edition, Prentice Hall of India Pvt Ltd, New Delhi, India, 1996.
2. "Introduction to Biomedical Equipment Technology" by Carr J., and Brown J., Pearson Education, 2000.

Reference Books:

1. "Introduction to Biomedical Instrumentation", Kahalekar S.G., Sadhudha Prakashan, Nanded. 1998.
2. "Biomedical Instrumentation", Webster J. G., John Wiley and Sons, Hoboken, NJ, 2004.
3. "Biomedical digital signal processing", Tomplans W.J., PHI publication, New Dehli 2004

IN703 INSTRUMENTATION SYSTEM DESIGN

Teaching Scheme: 04L + 00T Total 04 **Credit: 04**

Evaluation Scheme: 15CT1 + 15CT2 + 10TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs 30min.

Basic concept of instrument Design: Functional requirements and Specification. Operational environment: - commercial, industrial, military.

Overview of Standards: NEMA, DIN, BIS, ANSI, CENELEC, IS, IEC751, IBR, NACE.

Reliability: Concept of Reliability, MTTR, MTBF, component screening, bath tub curve, Component ageing. Failure rate analysis, Statistical sampling criteria. Sampling for units with low failure rates, Redundancy. TMR, DMR.

Electronic design guidelines: Noise in electronic circuit, the design of low noise Circuits, Components limits, sensitive device, sensitive inputs, input Filtering, damping, suppressors.

Enclosure Design guidelines: Grounding and shielding techniques, protection against

electromagnetic interference and electrostatic discharge. Packaging for various operational environment including IP-51, IP-54, IP65, IP67 & IP68.

Hazardous Area Classification: Classification of hazardous Area. Protection Principle, Explosion & Flame proof Protection, Type of Protection-Oil or Liquid Emersion, Increase Safety. Intrinsic Safety, Safety Integrity Level. Hazardous Area Safety: Zener Barrier Introduction.

Control Panel Design: Design considerations, Type of control panel designs, ergonomics in design of control room, control room layout & design, cabling, wiring details.

Design of a control valve: Control Valve Definition, Control valve coefficient Characteristics of control valve, Selection of characteristics to suit the process for gas, vapor and liquid, Control valve sizing calculations for liquid & gas service, Cavitations, flashing, Control valve noise & its remedies, types of control valve.

Pressure Relief System: Evaluation of relief device, types &features-Conventional Valve, Balanced valve, Pilot operated valve, Ruptured Disk & their sizing for liquid, gas & vapors. PSV sizing for liquid service.

Installation Practices: Installation Procedure & Diagrams (Hook Ups) for Field Instruments like Temperature Gauge, Level Gauge, Pressure Gauge, Orifice Plate etc. Transmitters like DP type Flow, Pressure, Level (with stand pipe) etc. for Liquid & Gas Service, Control Valve with SMART Positioner, solenoid valve, ON-OFF Valve.

Calibration: Need for calibrations, Overview of calibration standard like ISO/IEC 17025:2005etc.Calibration procedure for Flow, Level, Pressure & Temperature Transmitter, Calibration for electrical instruments like Ammeter, Voltmeter etc.

Text Book:

1. "Applied Instrumentation in the Process Industries Andrew Williams Vol. I and Vol. II, Vol. III", Gulf Publishing Company, 1979.

Reference Books:

1. "Instrument Engineer Handbook, Process Measurement Volume I and Process Control Volume II", Liptak B .G., Chilton Book Company, 2001
2. "Process Control Instrumentation Technology", Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.
3. "A Course in Mechanical Measurements and Instrumentation", Sawhney A. K. and Puneet Sawhney Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998.
4. "Instrumentation for Process Measurement & Control", by Norman A. Anderson, 3rd Edition, CRC Press.

IN 704 OPERATION RESEARCH & MANAGEMENT

Teaching Scheme : 04L + 00T Total 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs.30min.

Operations Research: Introduction, characteristics, phases, limitations; model building and Classification of O.R. Models. Linear Programming- formulation, simplex methods

Transportation problems: Introduction, methods, LP formulation of transportation problems, methods for finding initial solution, Modi's Approximation method.

Assignment Problems: introduction, mathematical statement and solution methods of assignment problems, variations of assignment problems.

Network Models: Network models - Network construction, PERT analysis, CPM analysis, cost analysis, updating, resource smoothening and leveling.

Waiting line models: Introduction classification of waiting line models, analysis of M/M/1 and M/M/S models, application of simulation to waiting line model and Monte Carlo technique. Sequencing-Processing of n jobs through 2 machines, n jobs through machines, 3 jobs through n machines, n jobs through n machines.

Replacement Models: Individual and group replacement models(basic problems only).

Simulation: Introduction, basic nature of simulation, when to simulate, advantages and limitations, role of random numbers in simulations, generation of random numbers

Text Book:

1. "Operations Research", H. Taha 6th edition PHI 2000
2. "Operations Research", Hira & Gupta S. Chand Publication 2000

Reference Books:

1. "Operation Research", Panneerselvam 2nd edition PHI 2008.
2. "Linear Programming", Paul Loomba, 3rd edition, PHI, 1964.
3. "Fundamentals of Operations Research", R. L. Ackoff and M.W. Sasieni, Jhon Willy and Sons Inc(Feb. 1968)

IN705 ELECTIVE - I

A) OPTOELECTRONIC INSTRUMENTATION

Teaching Scheme : 04 L + 00T Total: 04 **Credits : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction of Light: Light and Elements of solid state physics, nature of light, wave nature of light, light Source, black body radiation, unit of light, Energy bands in solids, semiconductor type works function.

Display Devices: Luminescence, Insestion Lurninescence and the light emitting diode, Radioactive recombination processes, LED materials, Commercial LED materials, LED construction, response time of LEDs, LED drive circuitry, plasma display, liquid crystal displays

Lasers: Emission, population inversion, optical feedback, classes of laser, doped insulator lasers. Semiconductor lasers, gas lasers, liquid dye lasers, laser applications, measurement of distance, holography.

Optical Fibers: Classification of optical fiber, principle of light transmission through a fiber, fabrication of optical fibers, material consideration, loss and band width limiting mechanism, perform fabrication technique, fiber drawing, fiber optic communication system.

Optical Sensors : Fiber optic sensors, intensity modulated sensors, microben strain intensity modulated sensor, liquid level types hybrid sensor, internal effect intensity modulated sensor, phase sensor, diffraction grating sensors, sensors using single mode fiber, interferometric temperature sensor, distributed fiber optic sensors, polarization problem in interferometric sensors using single mode fiber. Medical applications of fiber sensors, Fabry-Perot fiber optic sensors, Electric field And voltage sensors, Chemical fiber optic gyroscopes, magnetic field and Current Fiber sensor, military and aerospace applications, important applications of integrated optic fiber technology, Local area networks.

Applications: Special applications, ADM, video link, satellite link, computer link, nuclear reactor link, digital video transmission in optical fiber networks, video compression, N.A. measurement, working of OTDR, microprocessor based OTDR,

applications of OTDR, dispersion measurements, Bit Error Rate (BER)measurement, attenuation measurement using OTDR, cut-off wavelength measurement, micro bending loss measurement.

Text Books:

1. "Optical Fiber Communications, Principles & Practice", John M. Senior, 2nd edition, Prentice Hall of India, 1996.

Reference Books:

1. "Optoelectronics: Fiber Optics and Lasers", Morris Tischler, A Lab Text Manual, 2nd Edition, McGraw Hill, 1992.
2. "Fiber Optics Handbook for Engineers & Scientist (Optical & Electro-optical Engineering Series)", Frederick C.Allard, McGraw Hill, 1990.
3. "Optical Fibers & Fiber Optic Communication Systems", Subir Kumar Sarkar, S. Chand & Co., 2001

IN705 ELECTIVE-I

B) INSTRUMENTATION FOR AGRICULTURE AND FOOD PROCESSING

Teaching Scheme : 04L + 00T Total: 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction: Necessity of instrumentation and control for food processing and Agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for Food quality.

Soil science and sensors: PH, conductivity, receptivity, temperature, soil moisture and salinity, ion concentration, measurements, methods of soil analysis.

Instrumentation for environmental conditioning of seed germination and growth.

Flow diagram: of sugar plant, sensors and instrumentation set-up for it, Flow diagram of fermenter and control (Batch process), Flow diagram of Oil extraction plant and instrumentation set-up, Flow diagram of Pesticides manufacturing process and control, Flow diagram of Diary and confectionary industry and instrumentation set-up.

Application of SCADA for DAM parameters and control: Water distribution and management control, Auto-Drip irrigation systems, Irrigation Canal management, upstream and downstream control concepts, supervisory control.

Automation in Earth Moving Equipment and farm implements: Pneumatic, hydraulic and electronic control circuits in harvesters, cotton pickers, tractors etc.

Application of SCADA and PLC in packaging industry: Leaf area, length, evapotranspiration, temperature, wetness and respiration measurement and data logging. Electromagnetic, radiation, photosynthesis, infrared and CV, bio sensor methods in agriculture. Application of SCADA in Electrical System, Application of SCADA in Distributed System.

Reaction type: Alkylation, Amination Dehydration: Dehydragenetion, Nitration & Oxidation

List of Chemical: Acetone, Acetylene, Alumina, Benzene, Butane, Naphtha, Natural gas, nitrogen, Lime.

Text Book:

1. "Chemical Process & design Hand Book", by Jems Spight , Tata McGraw Hill Publication, 2001.

Reference Book:

1. "Process Instrumentation, and Control Handbook", Considine D. M., McGraw Hill International, 1993.
2. "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II", Liptak B. G., Chilton Book Company, 2001
3. "Process Control Instrumentation Technology", Johnson C. D., 7th Edition, Pearson Education, New Delhi, 2003.

IN705 ELECTIVE - I

C) EMBEDDED SYSTEMS

Teaching Scheme : 04L + 00T Total: 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Embedded Systems Introduction: Hardware/software co-design, issues in deciding where to split the problem, examples of embedded systems, sensors and interfacing techniques. Design Challenges, Processor Technology, IC Technology, Design Technology, and Trade-offs.

Custom Single purpose processors: Hardware, Combinational logic design, Sequential logic design, Custom single purpose processor design, RT level Custom Single purpose processor design, Optimization.

Standard single purpose processors: Introduction, timers, counters and watchdog timers, UART, Pulse width modulators, controlling a DC motor using PWM, LCD controllers, Keypad controllers, stepper motor controllers, ADCs, Real time clock.

Memory: Memory write ability and storage permanence, common memory types, composing memory, memory hierarchy and cache, advanced RAM.

Introduction, Communication basics, Basic protocol concepts, ISA bus protocol: memory access, Arbitration, Priority arbiter, Daisy chain Arbitration, Network oriented Arbitration methods, multilevel bus architectures, Advanced communication principles, Parallel and serial communication, wireless communication, Layering, error detection and correction, serial protocols, parallel protocols, wireless protocols: IrDA, Bluetooth.

Introduction, Models and Languages, Basic state machine model: FSM, FSM with data path model, using state machines, concurrent process model, Concurrent processes, communication among processes, synchronization among processes, implementation, dataflow model, Real Time systems.

Programming Languages for Embedded Systems: Tools for building embedded systems - with case studies. Esterel is good for control applications / Handel-C is good for casting algorithms into re-configurable hardware, Embedded Software Development Methodology.

Text Book:

1. Embedded System, Rajkamal Tata Mc –Graw Hill 1st edition, 2003.
2. Real time systems, C. M. Krishna, Kang G Shine, McGraw Hill, 1996.

Reference Books:

1. An embedded software primer, D. E. Simon, Pearson Education, 2002
2. Computers as components: Principles of embedded computing system design, Wayne Wolf, Morgan Kaufman/Harcourt India, 2000
3. Real time systems, C. M. Krishna, Kang G Shin, McGraw Hill, 1997.

IN705 ELECTIVE-I

D) BIOMEDICAL SIGNALS AND PROCESSING

Teaching Scheme : 04L + 00T Total 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Basic Neurology: Nervous system, neuron, resting potential, biopotential, Nernst equation, electrical equivalents.

Electrical activity of the heart: Cardiac system, bipolar and unipolar lead system, Einthoven triangle, electrodes, electrocardiogram-normal and abnormal, exercise ECG, lead positioning, electrode positioning for Holter ECG recording, vector cardiography, signal conditioning and processing.

Electrical activity of neuromuscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, correlation of force and work, EMG integrators, signal conditioning and processing.

Electrical activity of the brain: Sources of brain potential, generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, EEG under Grandmal and petit mal seizures, signal conditioning and processing.

Electrical signals from visual system: Sources of electrical signals in eye, generation of

signals, electro-retinogram, electro -occulogram.

Electrical signals from auditory system: Generation of cochlear potential and nature, evoked responses, auditory nerves, signal conditioning and processing.

Noise and interference in biomedical signals: Sources of noise in biomedical signal recordings, filtering techniques-active and passive filters, digital filtering, grounding and shielding.

Computer applications and Bio-telemetry: Real time computer applications, data acquisition, compression and processing, remote data recording and management.

Text book:

1. Biomedical Instrumentation & Measurements, L.Cromwell, F.Weibell PHI publication, 1979.
2. Hand Book of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw-Hill Publication, 1987.

Reference Book:

1. Biomedical Digital Signal Processing", W. J. Tompkins, Prentice Hall of India, New Delhi, 1993.
2. Signal Analysis and Pattern Recognition in Biomedical Engineering", G. F. Ihbar, John Wiley and Sons, 1975.
3. Optimization of Computer ECG Processing, H.K. Wolf and P.W. Macfarlane(Editors),North Holland Publishing Co., Austerdun, 1980.

IN706 BIOMEDICAL INSTRUMENTATION LAB

Teaching Scheme : 02 P Total 02 **Credit : 01**

Evaluation Scheme: 25 Internal + 25 External **Total Marks: 50**

It is representative list of Practical. The instructor may choose experiments as per his choice (so as to cover entire content of the course) from the list or otherwise.
Minimum 8 Experiments should be performed.

1. To study different types of ECG, EEG, & EMG electrodes.
2. To perform the measurement of PQRS wave of ECG signal using Biomedical signal simulator
3. To measure BP using osillometric method
4. To measure heart sound graphically with phonocardiograph.
5. To measure different normal EEG signals by simulator.
6. To perform analysis of external cardiac pacemaker.
7. To measure intensity of shortwave diathermy
8. To measure Intensity of ultrasonic theory machine
9. To measure different electrical safety parameters of biomedical instrumentation.
10. To measure electrical energy of defibrillator.

Practical Examination:

Oral examination based on above report.

IN707 INSTRUMENTATION SYSTEM DESIGN LABORATORY

Teaching Scheme : 02P Total 02 **Credit : 01**

Evaluation scheme: 25 Internal + 25External **Total Marks: 50**

It is representative list of Practical. The instructor may choose experiments as per his choice (so as to cover entire content of the course) from the list or otherwise.
Minimum 8 Experiments should be performed

1. Case study: One lab instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2. Designing and preparing a PCB layout for electronic circuit and drawing it on drawing sheet.
3. Designing of a control panel along with detailed engineering drawings.
4. Designing a control valve for given specifications and detailing it with engineering drawings.
5. Design of a filter for typical noise problem
6. Design of any electronic intrinsically safe circuit.
7. Designing any transmitter and drawing its details.
8. PCB Etching, drilling, soldering of component.

Practical Examination:-

Oral examination based on above report

IN708 SEMINAR & PROJECT

Teaching Scheme: 06P Total 06 **Credit : 05**

Evaluation scheme: 50 Internal + 100 External **Total Marks: 150**

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100 marks divided in two parts, 50 marks for Seminar and 50 marks for project work.

A. Seminar:

1. Student shall select a topic for seminar which is not covered in curriculum. Student shall complete the conceptual study of the selected topic and expected to know functional and technical details of selected topic.
2. Before end of semester students shall deliver a seminar and submit seminar report in proper format consisting of
    - Literature survey
    - Concept
    - Functional and technical details
    - Present status
    - Future scope
    - Application
    - Comparison with similar technique
    - References
3. Student shall deliver a seminar on report submitted which shall be assessed by two examiner (one should be guide) appointed by HOD

B. Project:

1. Students have to complete project work in VIIth and VIIIth semester. In general a group of 4-5 students should be allowed to complete one project.
2. In VIIth semester students shall complete literature survey and finalized the topic for project.
3. They shall submit synopsis on the selected topic to HOD.
4. On approval of project topic, they shall complete the design work and procure the required components.
5. Before the end of the semester students shall submit one copy of progress report in proper format covering the total work completed by the group.
6. There shall be oral exam based on report submitted by student. The oral examination shall be conducted by two examiner (one should be guide) appointed by HOD

IN801: PROCESS INSTRUMENTATTION & CONTROL

Teaching Scheme : 04L + 00T Total 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction to Process control: Process characteristics, Types of processes, process characteristics and controllability, self regulating and non self regulating. Processes, interacting & non-interacting processes. Relative gain array & it's analysis.

Types of control system: Open Loop & Closed Loop Control System, .Multi-loop and multivariable Process control system, Design consideration for P, PI, PID, ON OFF Controller, Tuning of PID, Electronic PID, Feedback control, feed forward control, Cascade control, ratio control, auto selective control, adaptive control system, Split range Control.

Introduction to Safety Instrumented System: Level I, II, III, Seal, Cause & Effect of SIS, Safety Interlock (Not For Boiler) , Fire & Gas Systems – Zones.

Distillation column control: Flow control of distillate and bottoms products, reflux control, composition control, pressure & Temperature control.

Reactor control: Flow, temp, Pressure, endpoint controls, Reactor safety interlocks. Dryer control, pumps & compressor control, cooling Tower control, water treatment control.

Application of DCS and SCADA: Distillation columns, power plants, Iron and steel plants, cement Plants, oil and gas fields, paper and pulp industries. Introduction to SCADA System and its Application.

Introduction to Intelligent controllers: Optimal controller, predictive controller, Expert system and controllers, Artificial Neural networks controllers, fuzzy logic & Neuro fuzzy control system, linear and non linear controllers, Single loop and multiloop controllers, model based PID controllers.

Text Book :

1. Process Control System 3/e F. G. Shinskey, 2nd edition McGraw Hill, 1979.
2. Chemical process control by George Stephanopoulos PHI 2003.

Reference Books:

1. Process Control Handbook by Bela G. Liptak., Chilton Book Company, 2001
2. Computer Based Industrial Control by Krishnakant.PHI 1997
3. Process Instrumentation & Control Handbook Considine 5th edition McGraw Hill, 1995
4. SCADA : Supervisory Control & Data Acquisition by Stuart A. Boyer, 4th Edition, ISA Publication
5. Instrumentation for Process Measurement & Control by Norman A. Anderson, 3rd Edition, CRC Press.

IN802: PROJECT ENGINEERING & MANAGEMENT

Teaching Scheme : 04L + 00T Total 04 **Credit : 04**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE: 2hrs 30min.

Definition of the project, Project objectives, Need, Scope, Project implementation

Project Engineering: Documentation: Document system, Process flow sheet, Mechanical flow sheets, (P & I Diagrams), Standard Symbols and Legends, Instrument index sheet, Instrument Specification Sheets, Loop wiring diagram, Panel Drawings and Specifications, Plot Plans, hookup diagrams, Installation details, special drawings, Purchase Requisition, Piping specifications, Electrical specifications, Bid documents.

Procurement Activities: Vendor documents and Vendor drawing, Purchasing and Expediting, Job execution, Planning hints, Tendering and bidding process, Bid evaluation, Purchase Orders. Scheduling, Specifying instruments, Vendor selection, Shipping, Receiving and storing instruments, Installation and checkout, Project checklist, Design considerations, Equipment delivery.

Detailed Engineering and Documentation: Plant layout, drawing, Different wiring diagrams, Interlock diagrams, Control panel diagram, Instrument data sheet, Checklist, Tests and progress report, Control system documentation.

Design Criteria: Engineering Design Criteria, Pneumatic V/s Electronic V/s Hydraulics, Cost, Dependability, Safety, Maintenance, Process control requirements, Control centers, Location, Layout, Electrical classification, Utilities, Future and spare capacity, specifications for various measurement and control groups

Construction activities: Installation and commissioning activities and documents require, On site inspection and testing (SAT) installation, Bill of materials (BOM), Contracting, Cold commissioning and hot commissioning, Inspection and testing, Factory acceptance test (FAT). Control console, Centers and panels, Types, Inspection and specification.

Project Monitoring: PERT/CPM techniques, Project bar chart, Network diagram, Fixing critical path. Introduction to PMP, PMI, Steps of project management.

Text Book :

1. Applied Instrumentation in the Process Industries Andrew and William. Volume II 3rd edition 2002 Gulf Publishing Company.
2. Introduction to Operations Research, Hiller and Lieberman Tata McGraw Hill. 7th Edition, 2003

Reference Books:

1. Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II", Liptak B. G., Chilton Book Company, 2001
2. Project Management- A systems approach to planning, scheduling and controlling, Harold Kerzner, 9th Edition, 2006.
3. Management Systems, John Bacon, ISA Publications 2003.
4. Batch Control System, Fisher T. G. ISA Publications 2001
5. Instrument Installation Project Management, ISA Publications2000

IN803 ELECTIVE - II

A) ADVANCED SENSORS

Teaching Scheme : 04L + 1T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction to advanced sensors technology: Design and Development of sensors using VLSI technology, Silicon Planar technology, Micromachining technology. MicroElectroMechanical Systems (MEMS) overview.

Design of sensors: Micro sensors for sensing radiation, mechanical, magnetic, chemical and other signals. Thick and thin film sensors, design principles. Semiconductor sensors fabrication principles: Metal Oxide Semiconductors (MOS) structures, Process steps such as RCA cleaning, Thermal oxidation, Lithography, Etching, Metalization etc.

Chemical and biochemical sensors: Polymers, Chemically modified Electrodes (CME), affinity sensors, Potentiometric and Amperometric devices, catalytic sensors, Gas sensors Optical sensors: Lasers, Photo-detectors and optical fiber as sensors, integrated optics.

Interfacing and Signal processing: Intelligent and Smart sensors, Concepts of redundant and multisensory systems. Study of sensor design software and simulation packages such as IECTCAD, Tanner tools, AutoCAD etc. Case studies.

Text Book:

1. Silicon Sensors, Middlehock S. and Audel S. A., Academic Press, London 1999.
2. Solid State Chemical Sensors, Jiri Janata and Robert J. Huber, Academic Press, Inc. London, 1985.

Reference Book:

1. Semiconductor Sensors, S. M. Sze, Wiley-Interscience (October 1994)

IN803 ELECTIVE -II

B) NEURAL NETWORKS AND FUZZY LOGIC CONTROL

Teaching Scheme : 04 L +01 T Total - 05 **Credits : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA+ 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs 30min

Introduction Neural Network : Biological Neurons and their artificial models introduction to neural computing, Components of neuron, input and output weight, threshold, weight factors, transfer functions, concepts of supervised and unsupervised learning.

Supervised Learning: Single layer network, perceptron, Linear separability, Training algorithm and limitations. Multilayer Network: Architecture of feed forward network, learning rule, generalized delta rule, learning function. Back propagation algorithm.

Unsupervised Learning: Introduction, Counter propagation networks, Kohonen's self

organizing maps. Hopfield networks.

Introduction to Fuzzy logic: Uncertainity in information, basic concepts of Fuzzy sets,

operations on Fuzzy sets, properties. Fuzzy relations: operations, properties, value assignments.

Membership functions: Features, fuzzification, membership value assignments, Fuzzy

Rule based systems Graphical technique of inference. Defuzzification: Lambda-cuts for Fuzzy sets and Fuzzy relations, Defuzzification methods.

Applications: Fuzzy pattern Recognition - feature analysis, partitioning of feature space, single sample identification multifeature pattern recognition. Simple Fuzzy logic controller - Control system design stages, Assumptions in a Fuzzy control system design, general fuzzy logic controllers, simple examples.

Text Book:

1. Fuzzy Logic with Engineering Applications Timothy Ross, McGraw Hill International Edition, 1995.
2. Neural Network Fundamental with Graphs, Algorithms and Applications, N. K. Bose and P. Liang, Tata McGraw Hill Edition, 1998.

Reference Books:

1. Fuzzy sets, Uncertainity and Information, G.J. Klir and T.A. Folger, PHI Publication, 1988.
2. Neural Networks & Fuzzy systems, Kosko Bart, Prentice Hall of India Pvt.Ltd., New Delhi, 1998.
3. Introduction to Artificial Neural Systems, J.M. Zurada, Jaico Publishing House, 2006.
4. Elements of artificial neural networks, Meherotra Kishan, Mohan C.K. Ranka Sanjay, Penram Int. Pub., Mumbai, 1996.

IN 803 ELECTIVE - II

C) COMPUTER NETWORK

Teaching Scheme : 04L + 1T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15CT2 + 10TA+60 ESE **Total Marks: 100**

Duration of ESE: 2hrs 30min.

Introduction: Brief history of computer networks & Internet, Layered architecture, Internet protocol stack, Network entities & layers, Application layer, Principles of protocols, HTTP, FTP, SMTP and DNS protocols.

Transport layer: services & principles, multiplexing & demultiplexing applications, UDP, principles of reliable data transfer, TCP details, principles of congestion control, TCP congestion control.

Network layer: network service model, routing principles, hierarchical routing, Internet

Protocol (IP) & ICMP details, routing in the Internet, router internals, IPV6.

Link layer: Introduction, services, multiple access protocol, LAN addresses & ARP, CSMA / CD, PPP details.

Network security: Basic issues, principles of cryptography, authentication and authentication protocol, version, integrity, digital signatures, message digests, hash function algorithm, key distribution & certification, secure e- mail , E – Commerce : SSL

& SET, IP sec details.

Network Management: Basic principles, infrastructure for network management, The Internet Network – management framework: SMI, MIB, SNMP details, security and administration, ASN 1, Firewalls: Packet filtering and Application gateway.

Text Book:

1. Computer Networking, James F. Kurose & K W Ross, 3rd Edition ,Pearson Education, 2004
2. Computer Network & Internet, Douglas E. Comer 4th Edition , Addison Wesley, 2004

Reference Books:

1. Computer Networks, Andrew S. Tanenbaum 5th Edition, PHI Publication, 2002
2. Communication Networks, Leon Garcia & Widjaja 2nd Edition, TMH Publication, 2000
3. Data & Computer Communication, William Stallings, 7th Edition, Pearson Education, 2003

IN803 ELECTIVE - II

D) DIGITAL CONTROL SYSTEMS

Teaching Scheme : 04L + 01T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Digital control systems – Introduction, description of some physical systems, continuous versus digital control, Discrete-time signals, discrete time systems, sampling and reconstruction, digitizing analog controllers

The Z Transforms – Definition and evaluation of Z-Transform, mapping between the splane and the z-plane, the inverse z-transform, theorems of z-transform, limitation of Z transform method. The pulse transfer function, pulse, transfer function of zero order hold, responses between the sampling instants, signal flow graph method applied to digital systems, stability of digital control systems, jury stability criterion

State variable analysis of digital control systems: Introduction, state description of digital processors, state description of sampled continuous- time plant, state description of systems with dead time and sample and hold discrete state models using phase physical and canonical variables. Relation between state equation and transfer function and solution of state difference equations, controllability and observability.

Pole-placement design and digital state observer: Stability improvement by state feedback, digital control systems, with state feedback, dead beat control by state feedback, design of the full order and reduced- order state observers, linear digital regulator design (Finite time and infinite time problems)

Text Books:

1. Discrete time control system, Ogata K- Englewood cliffs prentice-Hall 1987.
2. Digital control and state variable methods, M. Gopal- Second Edition, Tata McGraw Hill 2002.

Reference Books:

1. Digital control system, Kuo B. C., 2nd edition Orlando florida saunders college publishing 1992.
2. Digital Control Engineering, M. Gopal, Wiley eastern 1992.
3. Digital control systems, Houpls C. H. and G. B.Lamont, McGraw Hill 1984.
4. Computer Process control with advanced control applications, P. B. Deshpande and R. H. Ash Second Edition, Instrument Society of America (ISA) publications, 1988.
5. Digital Control Systems, Vol-I, R. Iserman, Fundamentals, Deterministic Control, Second Edition, springer- Verlag, Berlin, Heidelberg 1989.

IN804 ELECTIVE-III

A) IMAGE PROCESSING

Teaching Scheme : 04 L + 01 T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 +10 TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min

Introduction: Origin and application of DIP, fundamentals steps and component of an

IP system. Element of visual perception, light and EM spectrum. Image sensing, acquisition, sampling and quantization. Basic relationship between pixels.

Spatial domain image enhancement: Gray level transformation. Histogram processing.

Enhancement using arithmetic/logic operation. Basics of spatial filtering. Smoothing spatial filters. Sharpening spatial filters. Combined methods.

Frequency Domain Image Enhancement: Fourier transform and frequency domain Smoothing frequency domain filters. Sharpening frequency domain filters. Homomorphic

filtering .Implementation of 2-D Fourier transform

Image restoration: Noise model. Restoration in presence of noise –only-spatial filtering.

Periodic noise reduction by frequency domain filtering. Linear , Position invariant degradation .Estimation of degradation function .Inverse filtering. Wiener filtering. Constrained LS filtering. Geometric transformations: Spatial and gray level interpolation

Color Image Processing: Color fundamentals. Color models. Pseudo color image

processing. Full color image processing. Color transformation .smoothing and sharpening. Color segmentation. Noise in color image .Color image compression .

Text Book:

1. Digital Image Processing"(2/e), Gonzalez R.C.& Woods R.E Pearson education
2. Digital Image Processing and Analysis, Chanda B. & Majumdar D. (PHI) edition 2000.

Reference Books:

1. Digital Image Processing (3/e), (John Wiley) Estern publication 1998
2. Digital Image Processing And Computer Vision, Schalkoff R.J. John Wiley & sons, 1989.
3. Computer Vision & Image Processing, Umbaugh S.E PHI, 1997.

IN 804 ELECTIVE - III

B) ADAPTIVE CONTROL

Teaching Scheme : 04L + 01T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE: 2hrs 30min.

Introduction: Definitions, History of adaptive Control, Essential aspects of adaptive control, Classification of adaptive control system: Feedback adaptive controllers, Feed forward adaptive controllers.

Model Reference Adaptive System: Different configuration of model reference adaptive systems; classification of MRAS, Mathematical description, equivalent representation as a nonlinear time-varying system, direct and indirect MRAS.

Analysis and Design of Model Reference Adaptive Systems: Model reference control with local parametric optimization (Gradient method), MIT rule, MRAS for a first order system, MRAS based on Lyapunov stability theory, Design of a first order MRAS based on stability theory, Hyperstability approach, Monopoli's augmented error approach.

Gain Scheduling: Introduction, the Principal, design of Gain Scheduling Regulators, nonlinear transformations, applications of gain scheduling.

Alternatives to Adaptive Control: Why not Adaptive Control? Robust High gain feedback control, Variable Structure schemes.

Practical aspects: application and Perspectives on adaptive control.

Text Books:

1. The Model Reference Approach, I. B Landau, Adaptive Control, New York; Marcel Dekker, 1979.
2. Adaptive Control, K. J. Astrom and B. Wittenmark, Addison Wesley Publication Company, 1989.

References Books:

1. P. A. Chin, Simulation and Implementation of self Tuning Controllers, B. Roffel, P. J. Vermeer, Prentice-Hall, Englewood cliffs, NJ, 1989.
2. Adaptive Control Systems, R. Isermann, K. Lashmann and D. Marko, Prentice – Hall International (UK) Ltd. 1992.
3. Stable Adaptive Systems, K. S. Narendra and A. M. Annaswamy Prentice Hall, Englewood Cliffs, New Jersey, 1989

IN804: ELECTIVE-III

C) SYSTEM IDENTIFICATION

Teaching Scheme : 04L + 01T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Discrete Time Random Process: Random Variables Definitions, Ensemble Averages, Jointly Distributed Random Variables, Joint Moments Independent, Uncorrelated and Orthogonal random variable, Linear Mean Square, estimation, Gaussian Random Variables, Parameters Estimation- Definitions, Ensemble Averages, Gaussian Processes, Stationary Processes, the Covariance and autocorrelation matrices, Ergodicity, White Noise, the Power Spectrum, Filtering Ransom Processes, Spectral Realization, Special Types of Random Processes- MA, AR, ARMA, and Harmonic.

Linear Predication and Optimum Linear Filters- Rational Power Spectrum, Relationship between the Filter Parameters and the Autocorrelation Sequence, Forward and Backward Linear Prediction, Solution of the Normal, Equations- Levinson-Durbin Algorithm, the Shur algorithm, Properties of Linear-Prediction Error Filters, AR Lattice and ARMA Lattice Ladder filters, Wiener Filters for Filtering and Prediction- FIR Wener Filter, IIR Wener Filter, Noncausal Wener Filter.

Signal Modeling and System Identification:- System Identification based on FIR(MA), All-Pole (AR) and Pole-Zero (ARMA) Models- Pade Approximation, Prony's method, Shank's Method, Least-Square Filtering Design for Prediction and Deconvolution.

Solution for Least Sequences, Estimation Problems: - Definition and Basic Concepts,

Matrix Formulation of Least Square Estimation Algorithm, Cholesky Decomposition, LDV Decomposition, QR Decomposition, Gram-Schmilt Orthogonalization, Givers Rotation, Householder's Reflection, Singular Valve Decomposition (SVD).

Power Spectrum Estimation: - Estimation of Spectra form Finite Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Method for power spectrum estimation, Minimum variance spectral estimation, Eigen analysis algorithms for spectrum estimation.

Text Book:

1. Advanced Digital Signal Processing, Macmillan Publishing Company, New York, 1992
2. Hayes M. H., Statistical Digital Signal Processing and Modeling, John Wiley and Sons INC. New York, 1996.

Reference Books:

1. System identification by L. Ljung, PHI Publication. Edition 1986
2. Applied System Identification by J.N. Juang PHI Publication. Edition 1994
3. System Identification Advances and case studies by R.K.Mehra , D.G.Lainion's edition 1976

IN 804 ELECTIVE - III

D) NONLINEAR CONTROL

Teaching Scheme : 04L + 01T Total 05 **Credit : 05**

Evaluation Scheme: 15 CT1 + 15 CT2 + 10 TA + 60 ESE **Total Marks: 100**

Duration of ESE : 2hrs 30min.

Introduction: Introduction to nonlinearities and non linear phenomenon, Nonlinear system behavior, Examples.

Phase Plane Analysis: Concepts of Phase Plane Analysis: Phase Portraits; Singular

Points; Symmetry in Phase Plane Portraits, Methods of Constructing Phase Portraits: Analytical method, The method of Isoclines, Determining time form Phase Portraits, Phase Plane Analysis of linear systems, Phase Plane Analysis of nonlinear systems, limit cycles and existence of limit cycle: Poincare, Benisons theorem.

Describing Function Method: Describing function fundamentals: An example of describing functions; Computing describing functions, Derivations of describing functions of common nonlinearities, Describing function analysis of nonlinear systems: The Nyquist Criterion and its extension: Existence of limit cycles; Stability of limitcycles; Reliability of describing function analysis, Introduction to dual input describing functions, Subharmonic and jump resonance.

Fundamentals of Lyapunov Theory: Introduction, Nonlinear Systems and Equilibrium Points. Autonomous and Non-autonomous systems, Concept of Stability, Asymptotic stability and exponential stability, Local and global stability, Linearization and Local stability, Lyapunov's linearization method, Lyapunov's direct method, Positive definite functions, and Lyapunov's functions, Equilibrium Point theorems; Lyapunov theorem for local and global stability, Invariant set theorems, System Analysis based on Lyapunov Direct method. Lyapunov analysis of linear time-invariant systems, Generation of Lyapnov functions. Krasovski's Method, The variable gradient method Physically motivated Lypunov functions, control design based on Lyapunov's direct method.

Advanced Stability Theory: Concepts of stability for non-autonomous systems, Lyapunov analysis of Non-autonomous systems, Lyapunov like analysis using Barbalat's Lemma, Positive linear system: PR and SPR transfer functions, The Kalman - Yakubovich Lemma, The Passivity formulation.

Feedback Linearization: Intuitive concepts: Feedback linearization and canonical form; Input-state; Input-output linearization, Mathematical tools, Input-state linearization of

SISO systems; Generating a linear input-output relation. Normal forms, The zerodynamics. Stabilization and tracking; Inverse dynamics and Non-minimum phase systems; Case study: Trajectory Control of Robot Manipulator.

Text Book:

1. Input describing Function and Nonlinear System Design, Gelb A. and Vander Velde ,W. E., Multiple, Mc Graw-Hill (1968).
2. Applied Nonlinear Control, J. E. Slotine and w. Li, Prentice Hall Inc. Englewood cliffs, New Jersey 1995.

Reference Books:

1. Nonlinear System Analysis, M. Vidyasagar, Prentice-Hall Inc. Englewood cliffs, New Jersey 1978.
2. Multiple Input describing Function and Nonlinear System Design, Gelb A. and Vander Velde W. E., Mc Graw-Hill (1968).
3. Nonlinear Control System: An Introduction, A. Isidori, Springer Yerlag, 1989. Nonlinear Automatic Control, Gibson, Tata Mc-Graw Hill, 1963.

IN807 PROJECT & SEMINAR

Teaching Scheme : 08P Total 08 **Credit : 07**

Evaluation scheme: 100 Internal + 150 External **Total Marks: 250**

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1. In continuation with the work completed in VII th semester, student shall complete the implementation of ideas given in synopsis , so that working model of project shall be complete before the end of semester.
2. Students shall submit final project report in proper format which shall include the work completed in VII th semester also.
3. Evaluation of progress by evaluation committee appointed by HOD twice in the semester VIIth semester
4. Final examination of project shall include demonstration of working model, presentation by student and oral examination based on total project work.
5. Project work shall be accessed by guide and one external examiner.